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TIME OIL/WELL 12A SUPERFUND SITE

FIVE-YEAR REVIEW REPORT

PREPARED

BY

REGION 10

U.S. ENVIRONMENTAL PROTECTION AGENCY

USEPA SF



1351599

Dana A. Rasmussen
Dana A. Rasmussen
Regional Administrator

APR 26 1993
Date

EXECUTIVE CORRESPONDENCE

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**Five-Year Review
Commencement Bay - South Tacoma Channel
Well 12A Superfund Site
Tacoma, Washington**

I. Purpose of the Five-Year Review:

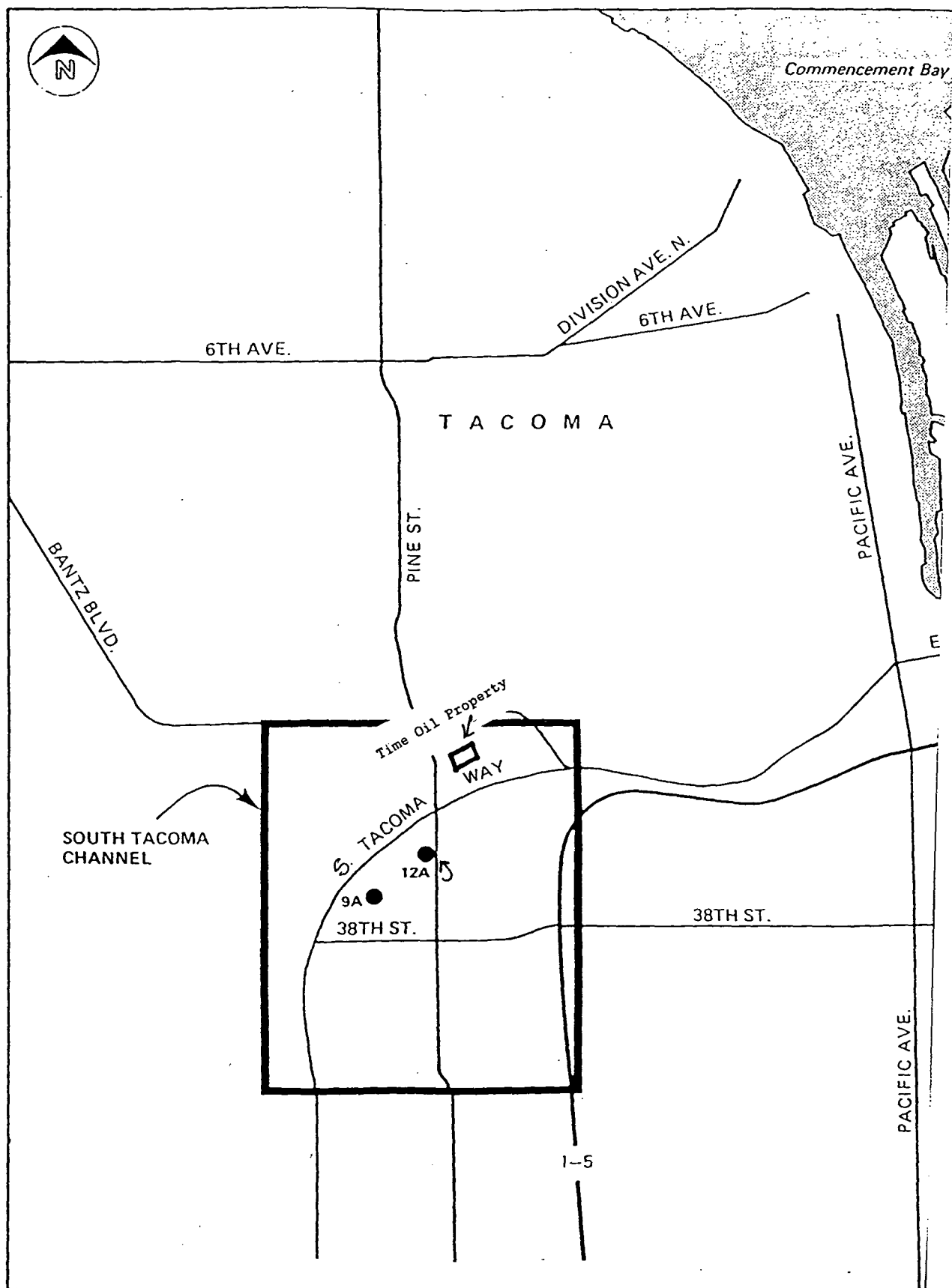
Region 10 of the Environmental Protection Agency (EPA) has conducted a Five-Year Review of the Commencement Bay, South Tacoma Channel - Well 12A Superfund site (Well 12A), and prepared this report consistent with the requirements of Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended in Section 300.430(f)(4)(ii) of the National Contingency Plan (NCP).

The start of construction of the remedial action in September, 1987, triggered the CERCLA Section 121(c) requirements for a Five-Year Review. As a matter of policy, EPA will conduct reviews of sites that will require five (5) or more years to achieve performance standards. This Five-Year Review was conducted pursuant to the Office of Solid Waste and Emergency Response Directives 9320.2-3A and -3B (April, 1989, and December 29, 1989, respectively), which established December, 1992 as the date for completion of Policy Five-Year Reviews. This Five-Year Review Report is consistent with the OSWER guidance.

The purposes of Five-Year Reviews are to confirm that the remedy remains effective at protecting human health and the environment and to evaluate whether the original cleanup levels remain protective. If the review determines the remedy is no longer protective, appropriate action to correct the remedy may be initiated. Deletion of the site from the National Priorities List (NPL) does not affect the need for Five-Year Reviews or prevent restoring the site to the NPL without application of the Hazard Ranking System.

II. Site Location and Description:

The "Well 12A site" is an operable unit of the Commencement Bay, South Tacoma Channel Superfund site located in Tacoma, Washington (Figures 1 and 2). The site encompasses the City of Tacoma's production Well 12A, and the source of the contamination, property owned by the Time Oil Company. Well 12A is located on Pine Street between 38th Avenue and South Tacoma Way. The Time Oil property is located at 3811 South Tacoma Way. The area near Well 12A includes industrial, commercial, and residential areas and is approximately 6 miles south of Commencement Bay, adjacent to Interstate 5 and State Highway 16.



● City of Tacoma Wells

Figure 1

Site Vicinity

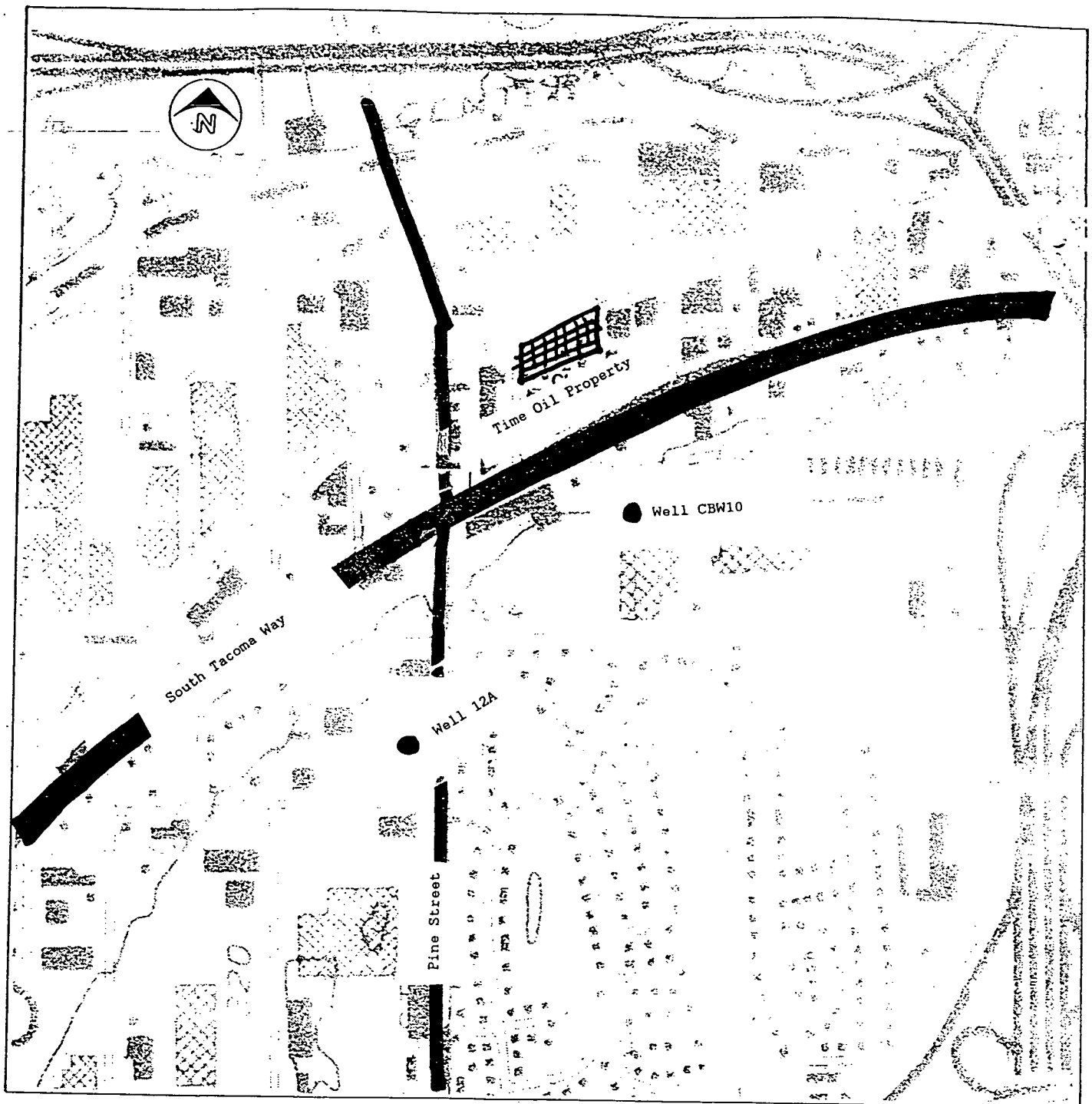


Figure 2

Site Location

Well 12A is one of 13 wells in a well field which provides 40% of the summer drinking water for Tacoma.

III. Site History:

A) Discovery:

On four different occasions between July and September of 1981, chlorinated organic solvents were detected in Well 12A. As a result, the City of Tacoma Water Department voluntarily removed Well 12A from production during September of that year.

EPA did a site investigation between July and September, 1981. Consequently, the site was proposed for listing on the National Priority List (NPL) on September 1, 1981. On September 8, 1983, Well 12A was added to the NPL.

B) Phase I Remedial Investigation:

In April, 1982, EPA authorized a Remedial Investigation (RI) to determine the source, type, and extent of the contamination. The levels of the groundwater contaminants of concern at the site were determined to be:

1,1,2,2-tetrachloroethane	- 17 to 300 ppb
1,2-trans-dichloroethylene	- 30 to 100 ppb
trichloroethylene	- 54 to 130 ppb
tetrachloroethylene	- 1.6 to 5.4 ppb

The study also determined that the major source of contamination was generally northeast of Well 12A.

During the RI, eleven monitoring wells were installed. By measuring groundwater elevation in the wells, it was determined that the natural, undisturbed groundwater flow direction was from west to east (and thus the contaminant flow was away from Well 12A) with a low velocity. However, with the well field in production, the flow direction reversed, and the plume was drawn towards the wells.

One conclusion of the RI was that Well 12A, if operated, would intercept the contamination drawn from the source area even if other production wells were pumping. In effect, Well 12A would provide a barrier to the spread of contamination and protect the rest of the well field. If Well 12A were not operated to provide a barrier, it was hypothesized that other

operating wells would draw the contaminant plume and would be lost for drinking water use.

C) Phase I Focused Feasibility Study/Initial Remedial Measures:

In January, 1983, EPA authorized a Focused Feasibility Study (FFS) to determine the most cost effective treatment for Well 12A that would protect the drinking water supply for the City of Tacoma. The study included an endangerment assessment that evaluated risks to the general population if no action was taken.

The FFS concluded that pumping and treating the water from Well 12A by air stripping was the only feasible remedial alternative that could be implemented on an interim basis to control the spread of contamination and prevent the loss of the well field. The available treatment methods were determined to be air stripping and carbon adsorption, and each was evaluated in laboratory tests. Because carbon adsorption was found to be more expensive than air stripping for the observed contaminant levels, it was eliminated from further evaluation.

On March 18, 1983, EPA signed a Record of Decision (ROD) for an Initial Remedial Measure calling for the design and construction of five air stripping towers operating in parallel to treat up to 3,500 gpm of contaminated groundwater and discharging treated water to either Commencement Bay or to the City's water system depending on measured quality and the City's needs. The decision level used to determine whether the treated well water would be discharged to the City water system or the bay was the 10^{-6} risk level determined at the tap (after dilution in the system).

The construction of this remedial action was authorized on March 24, 1983, and system startup occurred July 17, 1983. The system was operated by the City until early November of that year when the peak demand well field was no longer needed. Since that time, operation of the Well 12A treatment system by the City of Tacoma has continued on a seasonal basis to protect the well field. Operation will continue until remediation is completed.

D) Phase II RI/FS:

Because the phase I RI only identified a general source location and not a specific site, EPA authorized a study of historical solvent use and disposal practices in the suspect area in December, 1982. Records of past investigations by the Tacoma/Pierce County Health Department, Tacoma Water Division, and the State Department of Ecology were reviewed and interviews

were conducted with owners of numerous businesses in the area. A follow-up study focused on the historical uses and disposal of 1,1,2,2-tetrachloroethane (TCA) in the vicinity of Well 12A. The focus on TCA was based on the fact that the RI determined this chemical to be the predominant contaminant at the site, and an uncommonly used solvent. Since few businesses nearby used TCA, these studies reduced both the number and location of potential sources of the contamination by process of elimination.

In mid-May, 1983, EPA authorized a supplemental RI/FS to further define the extent of groundwater contamination and to attempt to locate the source. Four monitoring wells were installed. These, in addition to the previously installed monitoring wells, were sampled several times between July and November, 1993. One of the new wells located near the Time Oil, Fleetline, and Burlington Northern properties showed concentrations of trichloroethylene, 1,1,2,2-tetrachloroethane, and 1,2-trans-dichloroethylene in the low ppm range. This level was substantially higher than detected in other wells. It was consequently determined that these properties were at or near the contaminant source.

With the apparent source area narrowed down substantially, EPA obtained air and near surface soil samples along the Burlington Northern railroad spur adjacent to the Time Oil plant. Air sampling results showed very low levels of contaminants, but soil samples were very high in trichloroethylene and 1,1,2,2-tetrachloroethane, confirming that this was the source of the contamination. The soil underlying the railroad track was composed of a fine grained filter cake that had been used during oil reprocessing operations at the site. The filter cake was contaminated with high concentrations of lead (1 to 2%) as well as organics. Remedial alternatives were then developed to treat the soil and groundwater at the source and a proposed plan was issued for public comment.

E) Record of Decision:

The Record of Decision (ROD) for treatment of the source of contamination reaching Well 12A was signed on May 3, 1985, and consisted of the following major elements:

- Continue to operate the Initial Remedial Measures (IRM) (treatment of Well 12A effluent) until such time that the source control and remedial measures render the IRM unnecessary.
- Extract and treat the groundwater at the source to remove volatile organics, followed by discharge of a major portion of the treated extraction well effluent into Commencement Bay via an existing storm sewer. The remaining treated

extraction well effluent was to be recharged to the aquifer at the source area by means of a drain field in order to provide flushing of contaminants in the soil column.

- During the design phase, drill and sample up to 5 additional 30-foot soil test borings in order to better define the extent of soil contamination.
- Remove an appropriate length of railroad track adjacent to the Time Oil property and excavate the discolored, oily, fine-grained filter cake and soils under and adjacent to the railroad spur.
- Install drain field piping in the excavated areas and cover with a permeable material to protect the piping and prevent direct human contact with underlying soils.
- Pave or place a soil cover on the portions of the unpaved Time Oil parking lot not subject to excavation and flushing, in order to prevent direct human contact.
- Transport and dispose of all excavated, contaminated soils in a RCRA-permitted landfill.
- Maintain institutional controls prohibiting withdrawal of groundwater by private parties in portions of the aquifer where the level of hazard is in excess of 10^{-6} .
- Monitor groundwater to evaluate the performance of the treatment system.
- After two years of operation, evaluate the effectiveness of the groundwater extraction and treatment system in order to estimate the endpoint levels of treatment.

Essentially, the selected remedy for the site called for groundwater pump and treat using air stripping, excavation of contaminated soils and soil treatment by flushing to remove organics in subsurface soil.

The ROD allowed for changes in the remedy that were "equivalent in effectiveness and cost or are necessary for the protection of health and the environment". During the remedial design that followed (see below) the remedy was modified in a April 28, 1987, memorandum to the Regional Administrator to consist of soil treatment by a Vapor Extraction System (VES) and groundwater treatment using carbon adsorption.

F) ROD Cleanup Goals:

The ROD provides four alternatives for groundwater cleanup. The cleanup goals are based on treating the groundwater at the source (the Time Oil property) to levels where concentrations are at the 10^{-6} risk level at Well 12A, or at the Time Oil property boundary. Final selection of one of the cleanup goal alternatives will be based on operation data. The cleanup goals in the ROD (edited to be understandable out of context) are provided below in order of increasing length of treatment time and cost to reach the goal:

- A. Treat the groundwater at the source (the Time Oil site) so that the contaminant levels reaching Well 12A would allow the effluent from Well 12A to be discharged untreated to the bay, or with treatment, allow the utilization of the Well 12A effluent for the City water supply after dilution with other waters. This alternative would lower the potential risk of high contaminant concentrations from the source reaching the well.
- B. Treat the groundwater at the source in order to establish a level such that the untreated effluent from Well 12A could be used (after dilution with water from the rest of the well field) as drinking water.
- C. Treat the groundwater at the source and establish a level such that the Well 12A effluent would be at the 10^{-6} risk level with no dilution.
- D. Treat the groundwater to a level such that the groundwater at the source (within the property boundary) is at the 10^{-6} risk level.

The soil cleanup goals in the ROD are based on treatment until "the remaining contaminants pose no further threat to the groundwater". The determination of the appropriate levels was left to a later date.

G) Remedy Implementation:

A Remedial Design/Field Investigation report was completed in September, 1986. As part of this effort, a pilot VES system was installed on the Time Oil property, and the soil from the wells was sampled as they were drilled. In September, 1987, construction began on the carbon adsorption groundwater extraction and treatment system (GETS) to treat contaminated groundwater at the contamination source. The system was completed in the Spring of 1988 and is currently in operation. As of December, 1992, the system had treated over 237 million gallons

of water and removed over 8,600 pounds of volatile organic compounds (VOCs) from the groundwater.

The design for the VES system was brought to the 65% point by Woodward/Clyde in 1986. Because of lack of funding brought on by delay in reauthorization of CERCLA, the plan was shelved in favor of completing the design for the groundwater treatment system. An Inter-Agency Agreement with the U.S. Army Corps of Engineers (USACE) to complete the Remedial Design for the VES was awarded in July, 1988. State of the art for the design of VES had progressed since the original design, and a substantial design revision was necessary. The design was completed in April, 1991.

Construction of the VES for the Time Oil property began in September, 1992, and was completed in August of 1992. During construction, approximately 5000 cubic yards of filter cake contaminated with lead and organics was excavated and disposed of offsite in a hazardous waste landfill.

The VES is currently in the early stages of operation where problems with operation are being addressed (shakedown period).

H) Additional Site Investigations:

During the course of the Remedial Investigation/Feasibility Study and Field Investigation/Feasibility Study, the area to the west of the warehouse was not investigated (Figure 3). The area was inaccessible for sampling because it was covered with a 12" concrete pad, and contained cylindrical storage tanks, and piping related to the oil canning operation that was in operation on the site. However, information collected in November, 1991, as part of the Time Oil Investigation Report - Tasks 1 and 2 (ICF, 1991) indicated that drum storage and disposal had taken place in the area east of the warehouse, which was the area where high concentrations of organics were found during soil investigations.

The area west of the warehouse was vacated in 1991. The Time Oil Company, who occupied the property had removed all the piping and storage tanks and was preparing to remove the concrete from the area. Prior to permitting the removal of the concrete, EPA required that cores be made to determine whether contamination was present. The soil underneath the cores was stained and smelled strongly of VOCs. Thus, EPA determined that additional soil boring was required in this area.

Soil borings were drilled and sampled by EPA in February and March, 1992. The organic concentrations in the west warehouse area were in the 100 ppm VOC range. These results were not as high as those from the parking lot area where the VES is

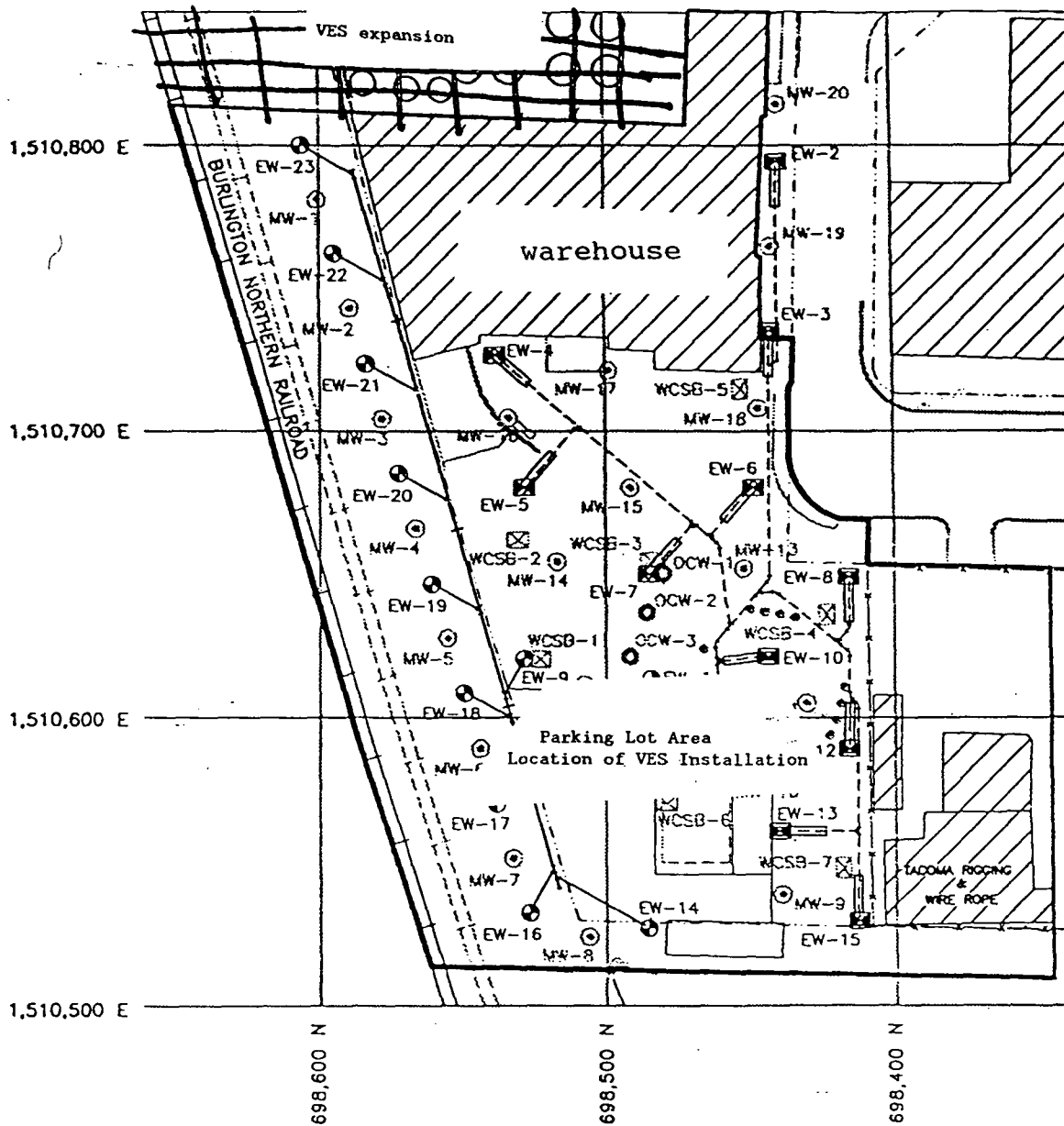


Figure 3

Time Oil Property

Locations of VES installation
and of Potential VES Expansion

currently installed (Figure 3), but sufficient to warrant a potential extension of the VES.

III. Current Status:

A) Groundwater Cleanup:

To date, there has been significant progress made in the remediation of the groundwater. Approximately 9000 lbs of organics have been removed to date. Although the current system is not sufficient to remediate the aquifer without additional extraction wells, the system is currently containing the plume and preventing it from migrating from the source area. Concentrations of organics in monitoring wells between the Time Oil property and Well 12A have decreased by 2 orders of magnitude, as shown by the following data from Well CBW10, a monitoring well between the Time Oil property and Well 12A (see Figure 2 for location of well, see Figure 4 for a graphic representation of the data):

Contaminant Concentration in Well CBW10

	April 1984 ¹	January 1987 ²	July 1992 ³
1,1,2,2-TCA	848 µg/l	1500 µg/l	10 µg/l
TCE	488 µg/l	920 µg/l	49 µg/l

¹ CH2M Hill, July 1984

² Ecology and Environment, March 1988

³ ICF, December 1992

Remediation of the groundwater will continue under a long term response action (LTRA). After the effective implementation of the VES, cleanup goals for the groundwater will be selected.

B) Groundwater Extraction and Treatment System Expansion:

The carbon adsorption groundwater extraction and treatment system (GETS) was designed for a total capacity of 500 gpm. The well capacity when the system began operating was approximately 200 gpm. In the subsequent years since operation, its capacity has been reduced to 100 gpm from siltation and iron bacteria buildup. In January, 1993, EPA began design of an extension of the system which will add the capacity for 4 additional extraction wells.

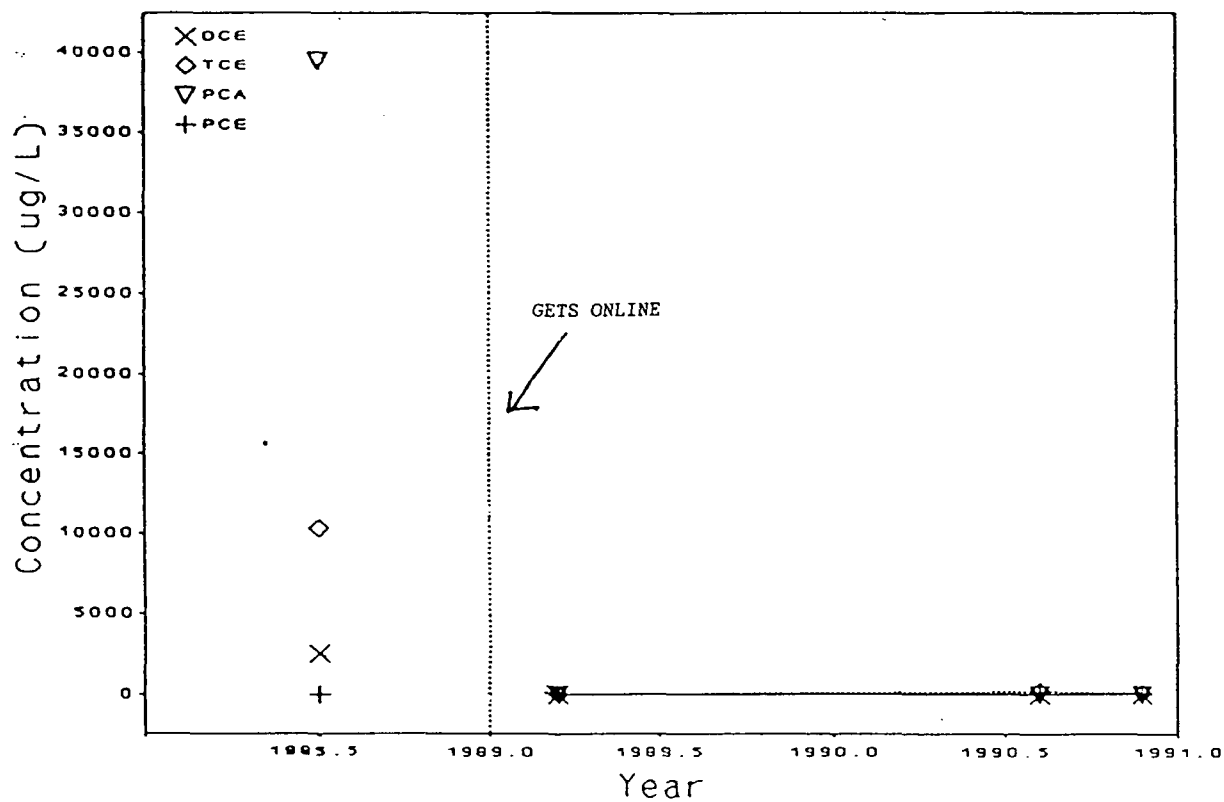


Figure 4
Trends in Contaminant Concentration
In Well CBW10

C) Soil Cleanup:

During installation of the VES, approximately 5000 cubic yards of filter cake contaminated with lead and organics was excavated and disposed of offsite. This eliminated most of the direct contact hazard from the site.

The VES went into operation in August of 1992. The design called for treatment of the contaminated gas stream with a solvent recovery system. In the system, the gas/VOC stream is adsorbed onto vapor phase carbon. When the carbon is saturated, steam is used to desorb the contaminants. The steam is condensed and the water/organic mixture goes to a phase separator, with the solvents passing into a storage tank, and the water to an air stripper system where it is treated and discharged.

The system was designed to separate the heavier chlorinated solvents from water. However, since startup began, a lighter phase "fuel" layer has also been removed from the soil. This organic phase is mixing with the chlorinated solvents, creating a three phase system in the decanter comprised of water/organics, a light organic phase and a heavier organic phase. Because each solvent phase contains chlorinated solvents and the lighter fuel, density differences are small. Thus, full separation of the phases, which would occur if only chlorinated solvents were present, and which is required for proper system operation, is not occurring. The system is currently being evaluated for modifications to allow phase separation.

IV. Progress Toward Remedial Objectives:

The ROD did not specify a treatment level to be attained for groundwater. Rather, the ROD specified that "After two years of operation, evaluate the effectiveness of the groundwater extraction and treatment system in order to determine the endpoint level of treatment of the groundwater and soil at the source area."

As of this review, the VES has not gone into full operation. In addition, new extraction wells are being planned for the groundwater treatment system. Once all of the systems are in operation, a decision will be made on the final cleanup level to be attained by the groundwater and soil systems.

The extent to which organics can be removed by VES is based on the binding characteristics of the soil and the associated kinetics of the volatilization during treatment. Thus, although the soil cleanup goals will be related to the final cleanup goal for the groundwater, the extent of removal that the VES can achieve once it is in operation will be the determining factor.

If the VES is not able to remove organics to a level where they will not impact the groundwater, or if the levels remaining in the soil after the operation of the VES are outside of the EPA acceptable risk range of 1×10^{-4} to 10^{-6} , then the ROD requires that the site be capped. Capping will prevent infiltration of rain or surface runoff leaching the remaining organics into the groundwater, and/or prevent future contact with the remaining contaminants.

V. Summary of the Five Review:

The Five Year Policy Review was conducted according to procedures in OSWER Directive 9355.7-02, Structure and Components of Five-Year Reviews. Activities in this review consisted of:

- 1) Review of site-related documents and agreements
- 2) Review of monitoring data
- 3) Site visit and inspection
- 4) Community relations activities
- 5) Preparation of the Five-Year Review report

Documents reviewed for this report include:

Record of Decision, EPA, May 3, 1985.

Memorandum: Remedial Action at South Tacoma Channel, Well 12A, EPA, April 1987.

Evaluation of GET Effectiveness, Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, November 1991.

Time Oil Investigation Report, Tasks 1 and 2, Commencement Bay - South Tacoma Channel (Well 12A) Site, ICF, November 1991.

Time Oil Investigation Report - Task 3 Monitoring Well Installation Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, October 1992.

December 1989 Quarterly Monitoring Well Sampling Report Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, March 1990.

December 1990 Quarterly Monitoring Well Sampling Report Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, March 1991.

October 1991 Monitoring Well Sampling Report Commencement Bay,
South Tacoma Channel (Well 12A) Site, ICF, February 1992.

July 1992 Monitoring Well Sampling Report Commencement Bay, South
Tacoma Channel (Well 12A) Site, ICF, December 1992.

VI. Site Conditions:

A) Site Visit

EPA conducted a site visit on January 27 and 28, 1993, to physically inspect the site area including Well 12A, the groundwater extraction and treatment system compound, and the Time Oil property where the VES is located. The purpose of this visit was to ensure that there were no direct hazards to human health or the environment.

Well 12A

The area with the stripping towers is fenced to protect the well head and the towers from vandalism. There are no hazardous materials at this location.

GETS Compound

The GETS compound is fenced to protect the system from vandalism. The system contains two 20,000 pound carbon towers which adsorb chlorinated organics from the groundwater. Other than these, there are no contaminated materials in the compound.

Time Oil Property (VES location)

The Time Oil property is fenced to protect the VES from vandalism. During installation of the VES, all filter cake material contaminated with lead concentrations greater than 1000 ppm was removed from the site. Therefore, there is no longer a direct contact threat from surface material at the site. The parking lot was then backfilled and paved. The solvent storage tank which collects the organics following steam regeneration contains 2000-3000 lbs of extracted solvents. The tank will be emptied and the solvents sent offsite for disposal whenever the tank fills.

The area east of the warehouse is currently not being addressed by the VES. There may be an addition to the VES installed to remediate this area. Currently, the existing soil contamination is covered by a concrete slab and there is no exposure.

B) Community Relations:

Community interest in this site has been low. Area residents seem to be confident that the water they receive is safe, (Well 12A was taken out of service when contamination was discovered, and since the installation of the stripping towers, contamination going into the water supply system has not been detected). Public meeting attendance has also been low. Newspaper articles were written when the groundwater system went on line, and again at the start of VES construction. This has been the only press interest in the site.

A major goal of the community relations program has been to keep the Tacoma area informed of activities in the Commencement Bay, South Tacoma Channel study area. Fact sheets are periodically sent out covering the entire area.

VII. Cleanup Goal Attainment:

None of the potential cleanup goals proposed for the site have been attained for soil or groundwater as called for in the ROD (see Section III(F)). The selection of final cleanup goals will be made following simultaneous operation of the VES and GETS for 1 to 2 years.

Potential groundwater treatment levels

Based on current risk guidance, the levels for a 1×10^{-6} cleanup goal for the contaminants of concern are as follows:

Chemical	(1×10^{-6} risk)	MCL
1,1,2,2 Tetrachloroethane	0.1	n/a
tetrachloroethylene	2.0	5
trichloroethylene	3.0	5

concentrations in [$\mu\text{g/liter}$]

VIII. Recommendations/Technology:

Three treatment technologies are currently being employed to remediate the Well 12A site.

The stripping towers at Well 12A have been effective in treating the well water and allowing its use. The use of the stripping towers at Well 12A should continue until the

concentrations reaching the well head are within EPA's accepted risk range at the well head or at the tap.

Based on the progress that has been made at the site by the groundwater extraction and treatment system in removing organics from the groundwater, this is an appropriate treatment for containment and treatment of the groundwater contamination.

The VES is still not fully operational. According to EPA guidance and experience, the selected technology is appropriate for removing VOCs from contaminated soil.

IX. Statement of Protectiveness:

Groundwater treatment needs to continue in order to provide protection of human health and the environment. The VES remedy must be implemented in order to remove the source of the VOC contamination to the groundwater.

There is currently no threat to human health posed by the site from the groundwater or surface soil. The water from Well 12A is treated prior to discharge and all residences in the area are on the public water supply. Private wells for groundwater use are not permitted by local governments. Also, the Time Oil property has been cleared of all contaminated surface soil.

X. Next Review:

If the treatment systems are able to successfully treat the soil to a level where it will no longer effect the groundwater or pose a direct contact hazard, and the groundwater to a level allowing "unrestricted use and unlimited exposure", then there will not be a second five year review. /

XI. Implementation Requirements:

The VES system should be extended to the area east of the warehouse in order to treat the remainder of the contaminated soil. The installation of additional extraction wells is required to successfully treat the contaminated groundwater in an expeditious time frame.

XII. Conclusion:

At the Well 12A, South Tacoma Channel Site, the long term remedial action currently in operation is progressing toward attainment of cleanup goals necessary to protect public health and the environment. Excavation of the filter cake during the

installation of the VES has eliminated most of the direct contact hazard from the property. It is expected that following operation of the VES, the soil will no longer act as a source of groundwater contamination, or pose a direct contact hazard. The treated water from Well 12A meets drinking water requirements, and the treated water from the GETS system, meets requirements for discharge to the bay. It is anticipated that the ultimate cleanup will enable unrestricted use of Well 12A or use after dilution with water from other wells in the well field.

Reply To
Attn. Of: HW-113

MEMORANDUM

SUBJECT: Approval of the Five-Year Review for the
Commencement Bay South Tacoma Channel Site, Well 12A

FROM: Randall F. Smith, Director
Hazardous Waste Division

TO: Dana Rasmussen
Regional Administrator

Attached is the Five-Year Review for the Commencement Bay South Tacoma Channel Site, Well 12A. This report is intended to confirm that the remedy and cleanup levels chosen for this site remain protective.

The Groundwater Extraction and Treatment System (GETS) was installed in May 1988 and has been on-line since that time. Installation of the Vapor Extraction System was completed in August 1992. The system requires modification to allow for treatment of a lighter than water solvent being removed along with the chlorinated solvents. Once the system is operating the GETS and VES should reach cleanup goals in three to five years.

CONCURRENCE					
INITIAL	<i>SR</i>	<i>CK</i>	<i>CR</i>	<i>Randy Smith</i>	<i>D</i>
NAME	PROCHLIN	KRUEGER	RUSHIN	SMITH	Emerson
DATE	4/14/93	4/14/93	4/14/93		



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

APR 19 1993

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Dana A. Rasmussen
Regional Administrator

Date

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Well 12A Superfund Site
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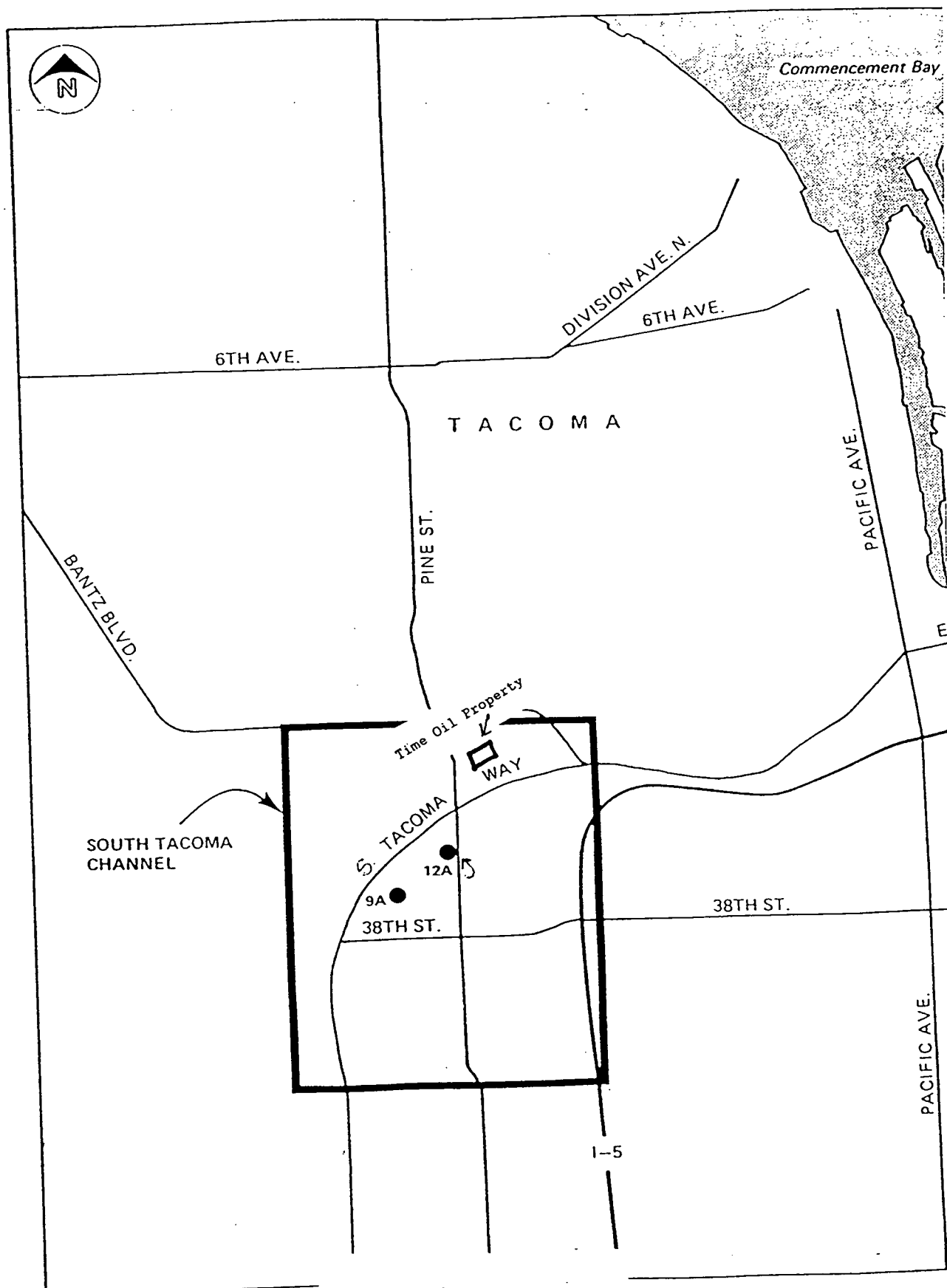
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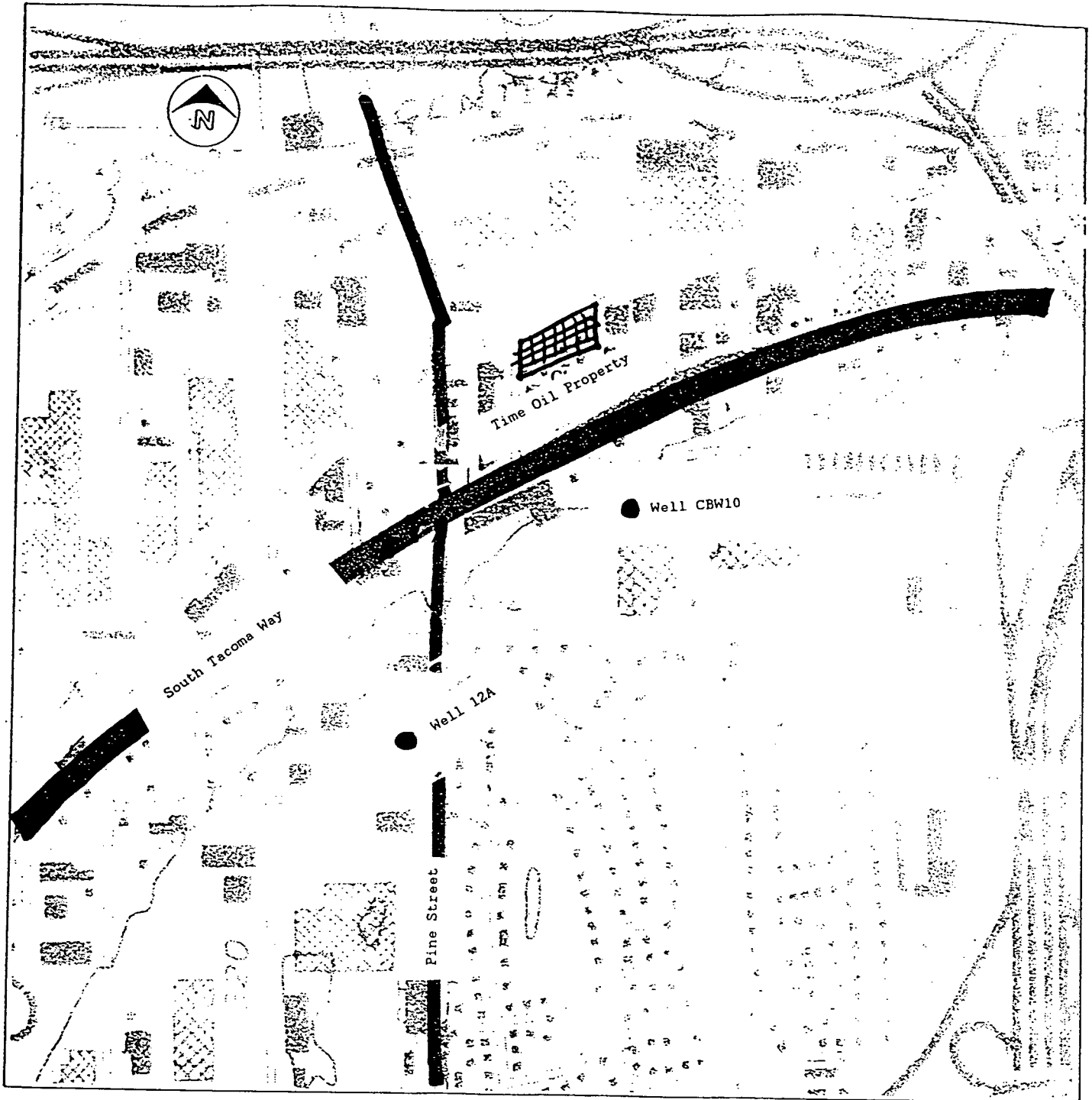


Figure 2

Site Location

Well 12A is one of 13 wells in a well field which provides 40% of the summer drinking water for Tacoma.

III. Site History:

A) Discovery:

On four different occasions between July and September of 1981, chlorinated organic solvents were detected in Well 12A. As a result, the City of Tacoma Water Department voluntarily removed Well 12A from production during September of that year.

EPA did a site investigation between July and September, 1981. Consequently, the site was proposed for listing on the National Priority List (NPL) on September 1, 1981. On September 8, 1983, Well 12A was added to the NPL.

B) Phase I Remedial Investigation:

In April, 1982, EPA authorized a Remedial Investigation (RI) to determine the source, type, and extent of the contamination. The levels of the groundwater contaminants of concern at the site were determined to be:

1,1,2,2-tetrachloroethane	- 17 to 300 ppb
1,2-trans-dichloroethylene	- 30 to 100 ppb
trichloroethylene	- 54 to 130 ppb
tetrachloroethylene	- 1.6 to 5.4 ppb

The study also determined that the major source of contamination was generally northeast of Well 12A.

During the RI, eleven monitoring wells were installed. By measuring groundwater elevation in the wells, it was determined that the natural, undisturbed groundwater flow direction was from west to east (and thus the contaminant flow was away from Well 12A) with a low velocity. However, with the well field in production, the flow direction reversed, and the plume was drawn towards the wells.

One conclusion of the RI was that Well 12A, if operated, would intercept the contamination drawn from the source area even if other production wells were pumping. In effect, Well 12A would provide a barrier to the spread of contamination and protect the rest of the well field. If Well 12A were not operated to provide a barrier, it was hypothesized that other

operating wells would draw the contaminant plume and would be lost for drinking water use.

C) Phase I Focused Feasibility Study/Initial Remedial Measures:

In January, 1983, EPA authorized a Focused Feasibility Study (FFS) to determine the most cost effective treatment for Well 12A that would protect the drinking water supply for the City of Tacoma. The study included an endangerment assessment that evaluated risks to the general population if no action was taken.

The FFS concluded that pumping and treating the water from Well 12A by air stripping was the only feasible remedial alternative that could be implemented on an interim basis to control the spread of contamination and prevent the loss of the well field. The available treatment methods were determined to be air stripping and carbon adsorption, and each was evaluated in laboratory tests. Because carbon adsorption was found to be more expensive than air stripping for the observed contaminant levels, it was eliminated from further evaluation.

On March 18, 1983, EPA signed a Record of Decision (ROD) for an Initial Remedial Measure calling for the design and construction of five air stripping towers operating in parallel to treat up to 3,500 gpm of contaminated groundwater and discharging treated water to either Commencement Bay or to the City's water system depending on measured quality and the City's needs. The decision level used to determine whether the treated well water would be discharged to the City water system or the bay was the 10^{-6} risk level determined at the tap (after dilution in the system).

The construction of this remedial action was authorized on March 24, 1983, and system startup occurred July 17, 1983. The system was operated by the City until early November of that year when the peak demand well field was no longer needed. Since that time, operation of the Well 12A treatment system by the City of Tacoma has continued on a seasonal basis to protect the well field. Operation will continue until remediation is completed.

D) Phase II RI/FS:

Because the phase I RI only identified a general source location and not a specific site, EPA authorized a study of historical solvent use and disposal practices in the suspect area in December, 1982. Records of past investigations by the Tacoma/Pierce County Health Department, Tacoma Water Division, and the State Department of Ecology were reviewed and interviews

were conducted with owners of numerous businesses in the area. A follow-up study focused on the historical uses and disposal of 1,1,2,2-tetrachloroethane (TCA) in the vicinity of Well 12A. The focus on TCA was based on the fact that the RI determined this chemical to be the predominant contaminant at the site, and an uncommonly used solvent. Since few businesses nearby used TCA, these studies reduced both the number and location of potential sources of the contamination by process of elimination.

In mid-May, 1983, EPA authorized a supplemental RI/FS to further define the extent of groundwater contamination and to attempt to locate the source. Four monitoring wells were installed. These, in addition to the previously installed monitoring wells, were sampled several times between July and November, 1993. One of the new wells located near the Time Oil, Fleetline, and Burlington Northern properties showed concentrations of trichloroethylene, 1,1,2,2-tetrachloroethane, and 1,2-trans-dichloroethylene in the low ppm range. This level was substantially higher than detected in other wells. It was consequently determined that these properties were at or near the contaminant source.

With the apparent source area narrowed down substantially, EPA obtained air and near surface soil samples along the Burlington Northern railroad spur adjacent to the Time Oil plant. Air sampling results showed very low levels of contaminants, but soil samples were very high in trichloroethylene and 1,1,2,2-tetrachloroethane, confirming that this was the source of the contamination. The soil underlying the railroad track was composed of a fine grained filter cake that had been used during oil reprocessing operations at the site. The filter cake was contaminated with high concentrations of lead (1 to 2%) as well as organics. Remedial alternatives were then developed to treat the soil and groundwater at the source and a proposed plan was issued for public comment.

E) Record of Decision:

The Record of Decision (ROD) for treatment of the source of contamination reaching Well 12A was signed on May 3, 1985, and consisted of the following major elements:

- Continue to operate the Initial Remedial Measures (IRM) (treatment of Well 12A effluent) until such time that the source control and remedial measures render the IRM unnecessary.
- Extract and treat the groundwater at the source to remove volatile organics, followed by discharge of a major portion of the treated extraction well effluent into Commencement Bay via an existing storm sewer. The remaining treated

extraction well effluent was to be recharged to the aquifer at the source area by means of a drain field in order to provide flushing of contaminants in the soil column.

- During the design phase, drill and sample up to 5 additional 30-foot soil test borings in order to better define the extent of soil contamination.
- Remove an appropriate length of railroad track adjacent to the Time Oil property and excavate the discolored, oily, fine-grained filter cake and soils under and adjacent to the railroad spur.
- Install drain field piping in the excavated areas and cover with a permeable material to protect the piping and prevent direct human contact with underlying soils.
- Pave or place a soil cover on the portions of the unpaved Time Oil parking lot not subject to excavation and flushing, in order to prevent direct human contact.
- Transport and dispose of all excavated, contaminated soils in a RCRA-permitted landfill.
- Maintain institutional controls prohibiting withdrawal of groundwater by private parties in portions of the aquifer where the level of hazard is in excess of 10^{-6} .
- Monitor groundwater to evaluate the performance of the treatment system.
- After two years of operation, evaluate the effectiveness of the groundwater extraction and treatment system in order to estimate the endpoint levels of treatment.

Essentially, the selected remedy for the site called for groundwater pump and treat using air stripping, excavation of contaminated soils and soil treatment by flushing to remove organics in subsurface soil.

The ROD allowed for changes in the remedy that were "equivalent in effectiveness and cost or are necessary for the protection of health and the environment". During the remedial design that followed (see below) the remedy was modified in a April 28, 1987, memorandum to the Regional Administrator to consist of soil treatment by a Vapor Extraction System (VES) and groundwater treatment using carbon adsorption.

F) ROD Cleanup Goals:

The ROD provides four alternatives for groundwater cleanup. The cleanup goals are based on treating the groundwater at the source (the Time Oil property) to levels where concentrations are at the 10^{-6} risk level at Well 12A, or at the Time Oil property boundary. Final selection of one of the cleanup goal alternatives will be based on operation data. The cleanup goals in the ROD (edited to be understandable out of context) are provided below in order of increasing length of treatment time and cost to reach the goal:

- A. Treat the groundwater at the source (the Time Oil site) so that the contaminant levels reaching Well 12A would allow the effluent from Well 12A to be discharged untreated to the bay, or with treatment, allow the utilization of the Well 12A effluent for the City water supply after dilution with other waters. This alternative would lower the potential risk of high contaminant concentrations from the source reaching the well.
- B. Treat the groundwater at the source in order to establish a level such that the untreated effluent from Well 12A could be used (after dilution with water from the rest of the well field) as drinking water.
- C. Treat the groundwater at the source and establish a level such that the Well 12A effluent would be at the 10^{-6} risk level with no dilution.
- D. Treat the groundwater to a level such that the groundwater at the source (within the property boundary) is at the 10^{-6} risk level.

The soil cleanup goals in the ROD are based on treatment until "the remaining contaminants pose no further threat to the groundwater". The determination of the appropriate levels was left to a later date.

G) Remedy Implementation:

A Remedial Design/Field Investigation report was completed in September, 1986. As part of this effort, a pilot VES system was installed on the Time Oil property, and the soil from the wells was sampled as they were drilled. In September, 1987, construction began on the carbon adsorption groundwater extraction and treatment system (GETS) to treat contaminated groundwater at the contamination source. The system was completed in the Spring of 1988 and is currently in operation. As of December, 1992, the system had treated over 237 million gallons

of water and removed over 8,600 pounds of volatile organic compounds (VOCs) from the groundwater.

The design for the VES system was brought to the 65% point by Woodward/Clyde in 1986. Because of lack of funding brought on by delay in reauthorization of CERCLA, the plan was shelved in favor of completing the design for the groundwater treatment system. An Inter-Agency Agreement with the U.S. Army Corps of Engineers (USACE) to complete the Remedial Design for the VES was awarded in July, 1988. State of the art for the design of VES had progressed since the original design, and a substantial design revision was necessary. The design was completed in April, 1991.

Construction of the VES for the Time Oil property began in September, 1992, and was completed in August of 1992. During construction, approximately 5000 cubic yards of filter cake contaminated with lead and organics was excavated and disposed of offsite in a hazardous waste landfill.

The VES is currently in the early stages of operation where problems with operation are being addressed (shakedown period).

H) Additional Site Investigations:

During the course of the Remedial Investigation/Feasibility Study and Field Investigation/Feasibility Study, the area to the west of the warehouse was not investigated (Figure 3). The area was inaccessible for sampling because it was covered with a 12" concrete pad, and contained cylindrical storage tanks, and piping related to the oil canning operation that was in operation on the site. However, information collected in November, 1991, as part of the Time Oil Investigation Report - Tasks 1 and 2 (ICF, 1991) indicated that drum storage and disposal had taken place in the area east of the warehouse, which was the area where high concentrations of organics were found during soil investigations.

The area west of the warehouse was vacated in 1991. The Time Oil Company, who occupied the property had removed all the piping and storage tanks and was preparing to remove the concrete from the area. Prior to permitting the removal of the concrete, EPA required that cores be made to determine whether contamination was present. The soil underneath the cores was stained and smelled strongly of VOCs. Thus, EPA determined that additional soil boring was required in this area.

Soil borings were drilled and sampled by EPA in February and March, 1992. The organic concentrations in the west warehouse area were in the 100 ppm VOC range. These results were not as high as those from the parking lot area where the VES is

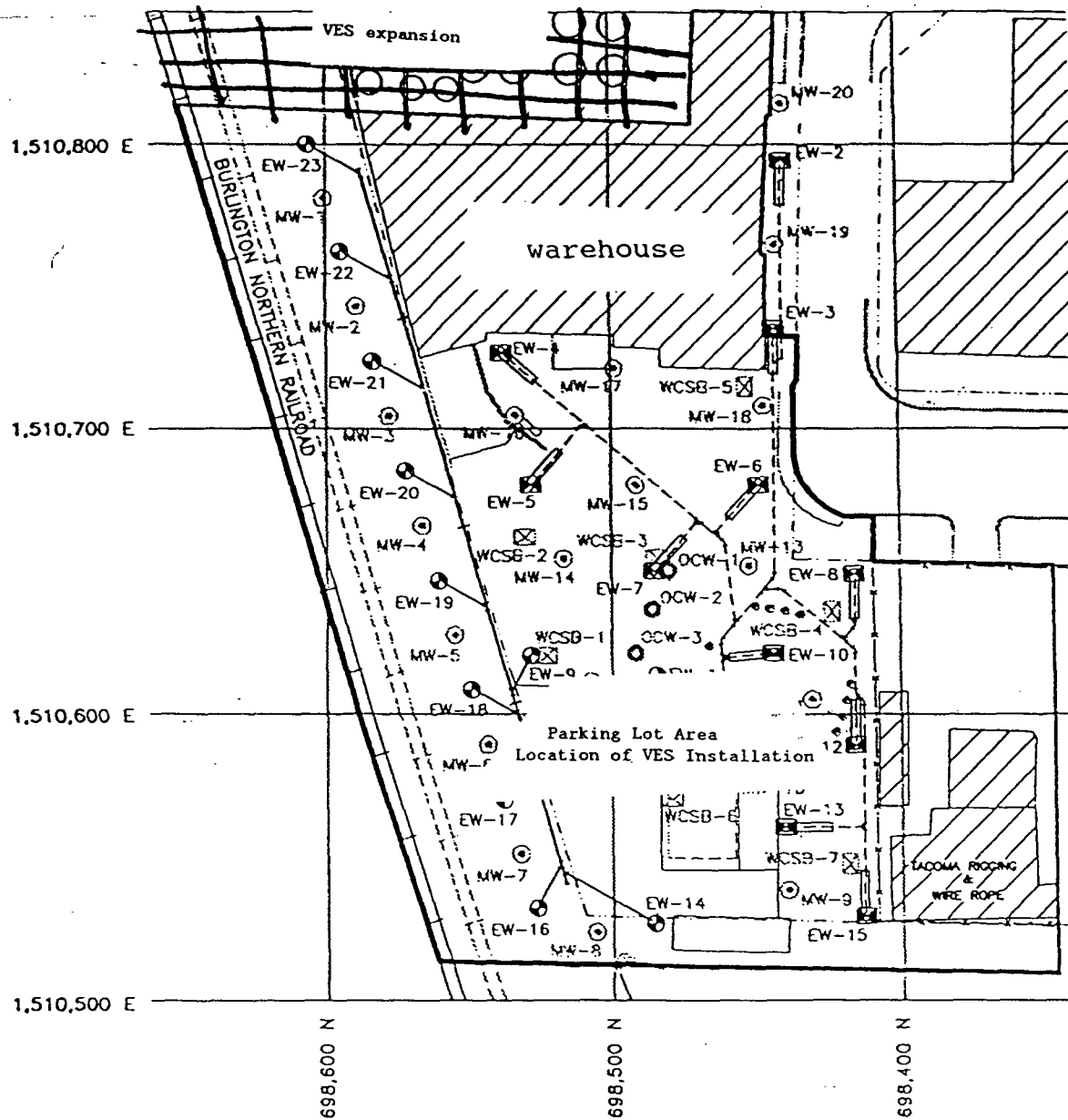


Figure 3

Time Oil Property

Locations of VES installation
and of Potential VES Expansion

currently installed (Figure 3), but sufficient to warrant a potential extension of the VES.

III. Current Status:

A) Groundwater Cleanup:

To date, there has been significant progress made in the remediation of the groundwater. Approximately 9000 lbs of organics have been removed to date. Although the current system is not sufficient to remediate the aquifer without additional extraction wells, the system is currently containing the plume and preventing it from migrating from the source area. Concentrations of organics in monitoring wells between the Time Oil property and Well 12A have decreased by 2 orders of magnitude, as shown by the following data from Well CBW10, a monitoring well between the Time Oil property and Well 12A (see Figure 2 for location of well, see Figure 4 for a graphic representation of the data):

Contaminant Concentration in Well CBW10

	April 1984 ¹	January 1987 ²	July 1992 ³
1,1,2,2-TCA	848 µg/l	1500 µg/l	10 µg/l
TCE	488 µg/l	920 µg/l	49 µg/l

¹ CH2M Hill, July 1984

² Ecology and Environment, March 1988

³ ICF, December 1992

Remediation of the groundwater will continue under a long term response action (LTRA). After the effective implementation of the VES, cleanup goals for the groundwater will be selected.

B) Groundwater Extraction and Treatment System Expansion:

The carbon adsorption groundwater extraction and treatment system (GETS) was designed for a total capacity of 500 gpm. The well capacity when the system began operating was approximately 200 gpm. In the subsequent years since operation, its capacity has been reduced to 100 gpm from siltation and iron bacteria buildup. In January, 1993, EPA began design of an extension of the system which will add the capacity for 4 additional extraction wells.

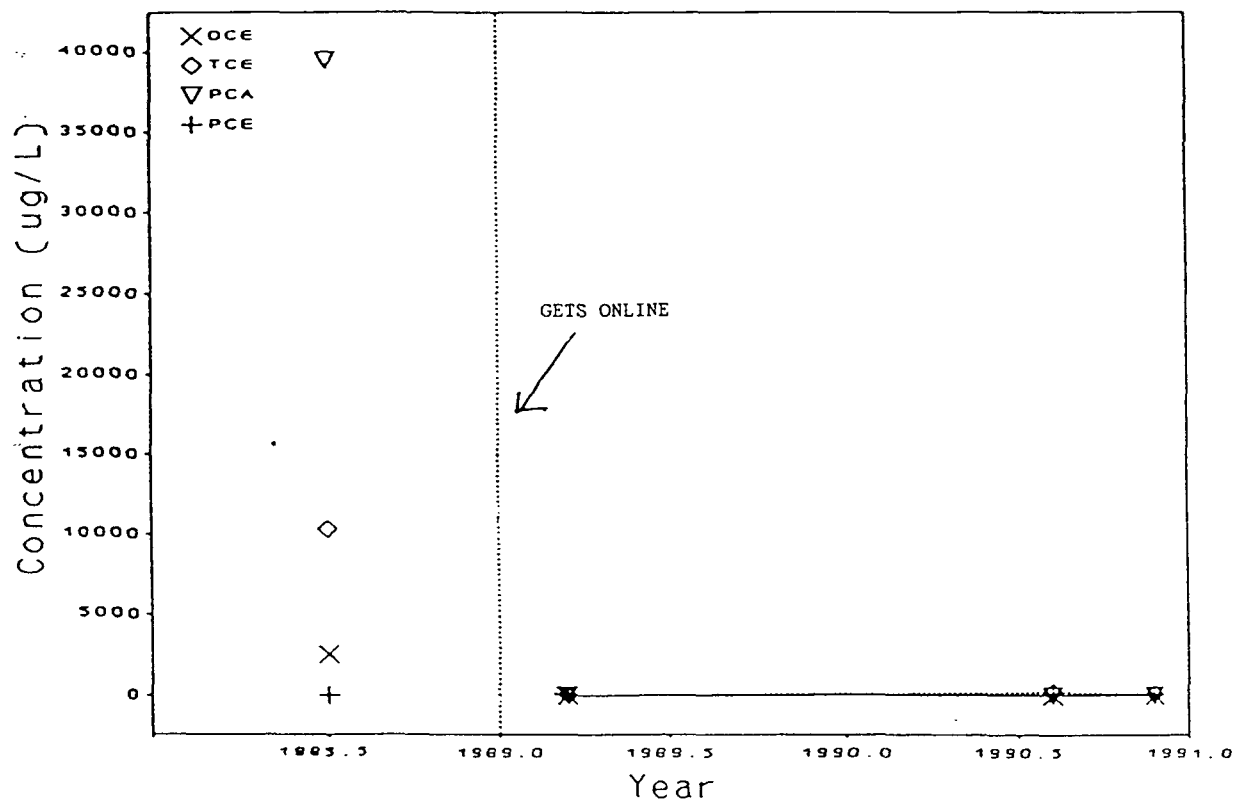


Figure 4
Trends in Contaminant Concentration
In Well CBW10

C) Soil Cleanup:

During installation of the VES, approximately 5000 cubic yards of filter cake contaminated with lead and organics was excavated and disposed of offsite. This eliminated most of the direct contact hazard from the site.

The VES went into operation in August of 1992. The design called for treatment of the contaminated gas stream with a solvent recovery system. In the system, the gas/VOC stream is adsorbed onto vapor phase carbon. When the carbon is saturated, steam is used to desorb the contaminants. The steam is condensed and the water/organic mixture goes to a phase separator, with the solvents passing into a storage tank, and the water to an air stripper system where it is treated and discharged.

The system was designed to separate the heavier chlorinated solvents from water. However, since startup began, a lighter phase "fuel" layer has also been removed from the soil. This organic phase is mixing with the chlorinated solvents, creating a three phase system in the decanter comprised of water/organics, a light organic phase and a heavier organic phase. Because each solvent phase contains chlorinated solvents and the lighter fuel, density differences are small. Thus, full separation of the phases, which would occur if only chlorinated solvents were present, and which is required for proper system operation, is not occurring. The system is currently being evaluated for modifications to allow phase separation.

IV. Progress Toward Remedial Objectives:

The ROD did not specify a treatment level to be attained for groundwater. Rather, the ROD specified that "After two years of operation, evaluate the effectiveness of the groundwater extraction and treatment system in order to determine the endpoint level of treatment of the groundwater and soil at the source area."

As of this review, the VES has not gone into full operation. In addition, new extraction wells are being planned for the groundwater treatment system. Once all of the systems are in operation, a decision will be made on the final cleanup level to be attained by the groundwater and soil systems.

The extent to which organics can be removed by VES is based on the binding characteristics of the soil and the associated kinetics of the volatilization during treatment. Thus, although the soil cleanup goals will be related to the final cleanup goal for the groundwater, the extent of removal that the VES can achieve once it is in operation will be the determining factor.

If the VES is not able to remove organics to a level where they will not impact the groundwater, or if the levels remaining in the soil after the operation of the VES are outside of the EPA acceptable risk range of 1×10^{-4} to 10^{-6} , then the ROD requires that the site be capped. Capping will prevent infiltration of rain or surface runoff leaching the remaining organics into the groundwater, and/or prevent future contact with the remaining contaminants.

V. Summary of the Five Review:

The Five Year Policy Review was conducted according to procedures in OSWER Directive 9355.7-02, Structure and Components of Five-Year Reviews. Activities in this review consisted of:

- 1) Review of site-related documents and agreements
- 2) Review of monitoring data
- 3) Site visit and inspection
- 4) Community relations activities
- 5) Preparation of the Five-Year Review report

Documents reviewed for this report include:

Record of Decision, EPA, May 3, 1985.

Memorandum: Remedial Action at South Tacoma Channel, Well 12A, EPA, April 1987.

Evaluation of GET Effectiveness, Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, November 1991.

Time Oil Investigation Report, Tasks 1 and 2, Commencement Bay - South Tacoma Channel (Well 12A) Site, ICF, November 1991.

Time Oil Investigation Report - Task 3 Monitoring Well Installation Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, October 1992.

December 1989 Quarterly Monitoring Well Sampling Report Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, March 1990.

December 1990 Quarterly Monitoring Well Sampling Report Commencement Bay, South Tacoma Channel (Well 12A) Site, ICF, March 1991.

October 1991 Monitoring Well Sampling Report Commencement Bay,
South Tacoma Channel (Well 12A) Site, ICF, February 1992.

July 1992 Monitoring Well Sampling Report Commencement Bay, South
Tacoma Channel (Well 12A) Site, ICF, December 1992.

VI. Site Conditions:

A) Site Visit

EPA conducted a site visit on January 27 and 28, 1993, to physically inspect the site area including Well 12A, the groundwater extraction and treatment system compound, and the Time Oil property where the VES is located. The purpose of this visit was to ensure that there were no direct hazards to human health or the environment.

Well 12A

The area with the stripping towers is fenced to protect the well head and the towers from vandalism. There are no hazardous materials at this location.

GETS Compound

The GETS compound is fenced to protect the system from vandalism. The system contains two 20,000 pound carbon towers which adsorb chlorinated organics from the groundwater. Other than these, there are no contaminated materials in the compound.

Time Oil Property (VES location)

The Time Oil property is fenced to protect the VES from vandalism. During installation of the VES, all filter cake material contaminated with lead concentrations greater than 1000 ppm was removed from the site. Therefore, there is no longer a direct contact threat from surface material at the site. The parking lot was then backfilled and paved. The solvent storage tank which collects the organics following steam regeneration contains 2000-3000 lbs of extracted solvents. The tank will be emptied and the solvents sent offsite for disposal whenever the tank fills.

The area east of the warehouse is currently not being addressed by the VES. There may be an addition to the VES installed to remediate this area. Currently, the existing soil contamination is covered by a concrete slab and there is no exposure.

B) Community Relations:

Community interest in this site has been low. Area residents seem to be confident that the water they receive is safe, (Well 12A was taken out of service when contamination was discovered, and since the installation of the stripping towers, contamination going into the water supply system has not been detected). Public meeting attendance has also been low. Newspaper articles were written when the groundwater system went on line, and again at the start of VES construction. This has been the only press interest in the site.

A major goal of the community relations program has been to keep the Tacoma area informed of activities in the Commencement Bay, South Tacoma Channel study area. Fact sheets are periodically sent out covering the entire area.

VII. Cleanup Goal Attainment:

None of the potential cleanup goals proposed for the site have been attained for soil or groundwater as called for in the ROD (see Section III(F)). The selection of final cleanup goals will be made following simultaneous operation of the VES and GETS for 1 to 2 years.

Potential groundwater treatment levels

Based on current risk guidance, the levels for a 1×10^{-6} cleanup goal for the contaminants of concern are as follows:

Chemical	(1×10^{-6} risk)	MCL
1,1,2,2 Tetrachloroethane	0.1	n/a
tetrachloroethylene	2.0	5
trichloroethylene	3.0	5

concentrations in [$\mu\text{g/liter}$]

VIII. Recommendations/Technology:

Three treatment technologies are currently being employed to remediate the Well 12A site.

The stripping towers at Well 12A have been effective in treating the well water and allowing its use. The use of the stripping towers at Well 12A should continue until the

concentrations reaching the well head are within EPA's accepted risk range at the well head or at the tap.

Based on the progress that has been made at the site by the groundwater extraction and treatment system in removing organics from the groundwater, this is an appropriate treatment for containment and treatment of the groundwater contamination.

The VES is still not fully operational. According to EPA guidance and experience, the selected technology is appropriate for removing VOCs from contaminated soil.

IX. Statement of Protectiveness:

Groundwater treatment needs to continue in order to provide protection of human health and the environment. The VES remedy must be implemented in order to remove the source of the VOC contamination to the groundwater.

There is currently no threat to human health posed by the site from the groundwater or surface soil. The water from Well 12A is treated prior to discharge and all residences in the area are on the public water supply. Private wells for groundwater use are not permitted by local governments. Also, the Time Oil property has been cleared of all contaminated surface soil.

X. Next Review:

If the treatment systems are able to successfully treat the soil to a level where it will no longer effect the groundwater or pose a direct contact hazard, and the groundwater to a level allowing "unrestricted use and unlimited exposure", then there will not be a second five year review.

XI. Implementation Requirements:

The VES system should be extended to the area east of the warehouse in order to treat the remainder of the contaminated soil. The installation of additional extraction wells is required to successfully treat the contaminated groundwater in an expeditious time frame.

XII. Conclusion:

At the Well 12A, South Tacoma Channel Site, the long term remedial action currently in operation is progressing toward attainment of cleanup goals necessary to protect public health and the environment. Excavation of the filter cake during the

installation of the VES has eliminated most of the direct contact hazard from the property. It is expected that following operation of the VES, the soil will no longer act as a source of groundwater contamination, or pose a direct contact hazard. The treated water from Well 12A meets drinking water requirements, and the treated water from the GETS system, meets requirements for discharge to the bay. It is anticipated that the ultimate cleanup will enable unrestricted use of Well 12A or use after dilution with water from other wells in the well field.